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**Declarative title:** Not too big, not too small: Blood pressure cuff size matters

**Commentary on:** Effects of Cuff Size on the Accuracy of Blood Pressure Readings: The Cuff (SZ) Randomized Crossover Trial - Ishigami et al<sup>1</sup>

## **Commentary**

### ***Implications for practice and research:***

- **Implications for practice:** The appropriate blood pressure (BP) cuff size should be selected for each patient based on arm circumference measurement.
- **Implications for research:** Investigation of barriers in NHS settings preventing clinicians from choosing appropriately sized BP cuffs.

### ***Context***

Hypertension is the foremost risk factor for cardiovascular disease (CVD)<sup>2</sup>. Accurate measurement of BP ensures the right people get the right treatment at the right time, but errors are common. One often overlooked issue is selecting the appropriate cuff size. “Under-cuffing” (using a too-small cuff) produces artificially raised BP readings while, “over-cuffing” (using a too-big cuff) produces artificially low BP readings<sup>2</sup>. Previous studies assessing the impact of incorrect cuff size used manual BP measurements, but these have largely been superseded by automated BP machines in clinical practice. Ishigami and colleagues conducted a randomised cross-over trial using automated BP machines and compared BP measurements established using regular-sized cuffs to BP measurements produced using appropriately sized cuffs.

### ***Methods***

Over 18’s with systolic BP of  $\geq 130$ mmHg were recruited in Baltimore, Maryland via community-based BP screening events, previous research participant invitations, study brochures in hypertension clinics, and direct physician referrals. Exclusion criteria included: pregnancy, no capacity to consent, arm circumference  $>55$ cm, paralysis and skin conditions, dressings or devices preventing BP cuff application to bare skin. A minimum of 35 participants were recruited to each group; small, regular, large or extra-large cuff size. Cuff size was determined by mid-upper arm circumference. Two trained researchers used the same model of automated BP machine to take twelve BP readings for each patient, split into four triplicate sets in a randomised order. Two triplicate sets were taken with the appropriately sized cuff, one with the too-large and one with the too-small cuff. Participants emptied their bladder and had the same walking and resting time before and after readings.

### ***Findings***

Statistically significant differences were found between systolic BP (SBP) and diastolic BP’s (DBP) using appropriate vs. inappropriate cuffs. When one size too large, SBP was underestimated by -3.6 mmHg (CI -5.6 to -1.7,  $p < 0.001$ ), and DBP by -1.3 mmHg (CI -2.4 to -0.2,  $p 0.02$ ). When one size too small SBP was overestimated by 4.8 mmHg (CI 3.0–6.6,  $p < 0.001$ ) and DSP by 1.8 mmHg (CI 1.1–2.6,  $p < 0.001$ ). When two sizes too small 19.5 mmHg (CI 16.1–22.9,  $p < 0.001$ ) and 7.4 mmHg (CI 5.7–9.1,  $p < 0.001$ ) overestimations in SBP and DBP were demonstrated respectively.

### ***Commentary***

Ishigami and colleagues demonstrated BP measurements taken using an automated BP machine with inappropriately sized cuffs were statistically different from measurements taken with a correctly sized cuff. These results are in line with previous research using manual auscultatory BP measurements<sup>3</sup>.

This is clinically meaningful, as a care setting using a regular sized BP cuffs for all patients is at risk of over-diagnosing hypertension in those with larger arms and under-diagnosing hypertension in those with smaller arms. Under-cuffing large arms is the most frequent mis-cuffing mistake<sup>4</sup> and can cause harm to patients via unnecessary investigations, prescribing, and hospital or GP visits for misdiagnosed hypertension. Around 26% of adults in England are now classed as obese<sup>5</sup>, so adjusting cuff size to arm circumference is increasingly important. Especially as these results show the degree of BP measurement error increased when the discrepancy in cuff size increased.

Hypertension is the major cardiovascular risk factor worldwide and the first step in reducing this risk is being able to accurately measure BP. This study highlights one source of error in BP measurement. A large systematic review of studies quantifying BP measurement inaccuracy cited 29 potential sources of error<sup>6</sup>. Home BP monitoring or ambulatory BP monitoring, as opposed to clinic BPs, are increasingly advocated by multiple guidelines. Further research could examine the impact of cuff size in these settings, as well as barriers to appropriate cuff size use. The findings of Ishigami and colleagues underline the importance of using the correct cuff size for BP measurement in clinical practice.

## **References**

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